

But to return to Dr. von Rohr's book. It is divided into two parts, theoretical and historical respectively; the first, occupying about 80 pages of the whole 400 in the book, is clear and interesting so far as it goes, but it is hardly satisfying. The author has abstained, no doubt wisely from some points of view, from attempting to give the mathematical proof of most of his propositions; the result is that the reader is often brought to a standstill with the question—But how does this follow? Without a much greater acquaintance with optics than can be gained from the book, he would find much of it difficult to read with profit. It is all very well to be told, to take at random a very simple example, that the correction for chromatic aberration for two colours depends, for a "thin" lens, only on the focal lengths and refractive indices of the two lenses concerned, and not on the curvature of their faces—so long as the focal length is not altered by change of curvature—but an intelligent reader would like a proof of this.

The author starts from Gauss' theory of lenses, which is only applicable to small pencils centrically incident and inclined at a small angle to the axis; he extends this practically by the assumption that lenses can be constructed for which Gauss' theory, freed from the restriction of nearly direct incidence, would hold strictly; and then he examines the points in which actual lenses differ from this ideal system.

Each error is discussed in turn, the method of correcting it is described, and the possibility of combining the corrections for various errors is considered. Admitting the difficulty of inserting the mathematical proofs, and the probability that if they had been inserted the book would have been useless to many for whom it was intended, it may be said that all this part is well done. The result of the discussion is summed up on page 56, in the section on Seidel's five spherical errors, and the impossibility of completely removing them from a photographic object-glass. A complete freedom from spherical aberration cannot be combined with absence of distortion for all positions of his object.

A further section of this part deals with chromatic aberration; the relations between the conditions for freedom from both spherical and chromatic aberration in a thick lens are specially well treated.

The second, and by far the larger, part of the book is an historical account of the development of a photographic objective, and this is written with great insight and judgment.

It may be felt by some that a too marked prominence is given, in the account of recent years, to the work of the Jena school; such prominence is only natural considering the circumstances of the author, and it is certainly true that he shows a high appreciation of the work of the distinguished English opticians, to whom so much of the advance in photographic lenses is due.

The work is very complete; it begins with the first camera obscura made by Giambattista della Porta in 1589, and carries us down to a lens patented by E. von Hoegh in 1899. The cuts illustrating the various lenses are carefully drawn—as far as possible to scale—reduced to a common focal length of 100 mm., and the nature of the glass used is indicated by special shading. Altogether the book deserves careful study.

#### EXPERIMENTS ON ANIMALS.

*Experiments on Animals.* By Stephen Paget, with an Introduction by Lord Lister. Pp. 269; 3 illustrations. (London: Fisher Unwin, 1900.)

THERE are many people who write about experiments upon animals, but only very few who have under their constant notice the actual facts relevant to the subject. In this connection, not merely is a knowledge of fact required, but an intellectuality capable of appreciating the significance of fact. The person most competent from this standpoint is one of the Inspectors under the Act. These Inspectors are most carefully chosen by the Home Office on account of special qualifications which they possess. It must not, however, be assumed that because they are the only officers paid by the Crown they are the only men of science who serve it. Most zealous and somewhat thankless help is afforded to them by those authorities who, by virtue of their position and attainments, are regarded as competent to support the candidate in his application for a license or certificate. It would not, however, be comely for a person holding an official appointment to write a book upon the subject-matter of his office. Every vivisector, a terrible term by which to designate any one who merely pricks a guinea-pig, knows full well that no one, with the above exceptions, is more entitled to write upon the subject of animal experiments than Mr. Stephen Paget, who for twelve years was the active and long-suffering secretary of the Society for the Advancement of Medicine by Research. During this time most licensees under the Act were brought into contact with the author of the book before us.

The volume does not simply concern itself with the working of the Act, but must be regarded as a weighty contribution to the polemical literature of the subject. It shows not only that the Act is vigorously worked by the authorities, but also enters largely into the question of the justification of animal experiment.

The part of the book devoted to this subject will be of the greatest interest to the general reader, and it is sincerely to be hoped that he will take advantage of it, for, while the diatribes of those who oppose all animal experiment are thrust almost weekly into the hands of the public, the *altera pars* says but little. Mr. Paget classifies the experiments that have up to the present been performed upon animals according to the individual field of medical science enriched by their results. The most casual reader must gather from his pages how in almost every domain, medicine, using this term collectively, has learnt from animal experiment, and how the treatment of disease has by its means advanced from mediæval empiricism to its present condition. To twit workers in the medical sciences with the fact that certain discoveries in physiology, established by means of vivisection, have not so far led to the curability of apparently cognate diseases, shows a want of that intellectuality which is capable of appreciating the significance of scientific fact. We might as well deny the value of the discovery of Africa because some parts of it are uninhabitable. As hygienic science advances, and our knowledge concerning both the methods of extinction of pathogenic micro-organisms, and the

neutralisation of their injurious products increases, no doubt some of the now malarial swamps will be converted into thriving colonies; and so is it with physiology, when by further experiment our knowledge of the *modus operandi* of the change from the physiological to the pathological is more complete, many facts now apparently barren will bear fruit a hundred-fold.

Those who apparently with such unctuous satisfaction point to the inability of even modern therapeutics to cope successfully with certain deadly diseases, are surely supplying an argument for more experimentation, and not for less. If medicine has not derived the full benefit possible from physiological discovery, it will do so later on. But what is regarded by the anti-vivisectionists as a benefit? One of them asks quite recently, and apparently quite seriously, what benefit has accrued to medicine from a knowledge of cerebral localisation.

Mr. Paget deals with many points in detail which have formed the text of many of the more or less scurrilous essays of both varieties of antivivisectionists; he succeeds in showing that their case is only skin deep, and that when care and some erudition are applied to the elucidation of the individual instance, the facts appear in quite another light.

The last part of Mr. Paget's work is devoted to the Prevention of Cruelty to Animals Act itself. He argues, with some reason, that however efficacious the Act might have been in 1876, since then a new science, bacteriology, has practically arisen. This science for the elucidation of its problems requires a special kind of technique, simple enough, but for which the Act is ill adapted. At the conclusion of this chapter some interesting accounts are given of questions in the House of Commons concerning the working of the Act, and some interesting letters reproduced, emanating from antivivisectionists, and threatening her Majesty's ministers with political destruction if they failed to use their influence against experiments on animals. The President of the Board of Agriculture seems especially to have incurred their wrath.

#### OUR BOOK SHELF.

*Cyclopedia of Classified Dates.* By Charles E. Little. Pp. vii + 1454. (New York and London: Funk and Wagnalls Co., 1900.)

It may be doubted whether this bulky volume is of sufficient value to justify the immense amount of labour that must have been spent in its compilation. There are no less than 95,000 entries of important (and unimportant) historical events, classified geographically, chronologically, and according to their nature, so that the where, when and what of any event can be discovered. The volume is intended to be a universal history, a biographical dictionary, a geographical gazetteer and many other books combined; in short, an omniscient and international Domesday Book. The only parts with which we have any concern are the divisions of science and nature included among several other groups of events recorded for each of the seventy-nine geographical divisions, which are arranged in alphabetical order. Many of the entries appear vague and trivial, and some are misleading, if not actually incorrect. As instances of information which comes under one or other of these criticisms, the following may be cited:—1089, a widespread earthquake is felt; 1737, Dr. James Bradley discovers the variation (*sic*) of the earth's axis; 1783, Walker produces ice in summer by means of chemical

mixtures; 1783, Herschel proves the binding (*sic*) rotary motion of the stars; 1787, quicksilver is frozen without the aid of snow or ice; 1827, the spectrum analysis is worked out by Herschel; 1848, William Lassell discovers the eight (*sic*) satellites of Saturn; 1852, Sir William Thompson (*sic*) discovers the dissipation of energy; 1861, Mr. Thompson, of Weymouth, photographs the bottom of the sea; 1867, nitrous oxide gas (laughing gas) is introduced; 1881, telephotography is invented by Shelford Bidwell; 1890, the bones of a hippopotamus are found imbedded in clay; and there are many others.

But the sins of commission are as nothing in comparison with those of omission. The only events recorded under science and nature in 1894 are the meeting of the British Association, and the departure of the Jackson-Harmsworth polar expedition; in 1893, an earthquake and a flood; in 1892, two earthquakes; and in 1891, the meeting of the international congress of hygiene and demography.

Judging from these facts, no serious attempt has been made to trace the progress of science in any of its branches in latter years. From our point of view, therefore, the book is of little value. In a charitable spirit we trust its merits in other sections help to make up its deficiencies in those referring to scientific matters.

*Justus von Liebig und Christian Friedrich Schönbein. Briefwechsel, 1853-1868.* By Georg W. A. Kahlbaum und Eduard Thon. Pp. xxi + 278. (Leipzig: Johann Ambrosius Barth, 1900.)

THE correspondence of Faraday and Schönbein, which was noticed in a former issue (Feb. 8), finds a companion volume in the work before us, which comprises 133 letters covering a period of fifteen years. Of these letters, eighty-four are from the pen of Schönbein. The same care as regards editing and annotation which was observable in the previous volume is a conspicuous feature of the present work.

The subjects dealt with by Schönbein are chiefly those which are referred to in his letters to Faraday, more especially ozone and the work arising from his investigations of that substance. Some of the letters are more or less personal and political, and will be found very interesting reading. Liebig's letters also are replete with topics of interest in the history of chemistry, and will repay detailed consideration.

Among the subjects dealt with are fermentation, food preservation, meat extract, and agricultural chemistry. It must be remembered that the views concerning fermentation, and the bearing of chemistry upon agriculture, were at that period in the polemical stage, and this imbues Liebig's statements with special interest. Both writers also from time to time soar from the commonplace recital of facts and discoveries into the higher regions of speculation and philosophy. Liebig's views on the place of Bacon in philosophy and science are referred to by Schönbein with approval (p. 166). Schönbein's views on theory as a stimulus to new discovery (p. 216) will also commend themselves to the majority of readers.

It will be gathered from this brief notice that the volume under consideration is as valuable a contribution to the history of science as its predecessor. R. M.

*Cina e Giappone.* By E. von Hesse Wartegg. Translated into Italian by Captain Manfredo Camperio. Pp. 536; illustrated by 168 woodblocks, 72 plates, *facsimiles* of manuscripts, and one map. (Milan: Ulrico Hoepli, 1900.)

THE opening up of China to foreign commerce has naturally created a demand for books dealing with the country and its inhabitants considered from every aspect; their religion, their treatment of missionaries, their laws,